Small Unmanned Air Vehicle Center of Excellence

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BYU

Technology Focus

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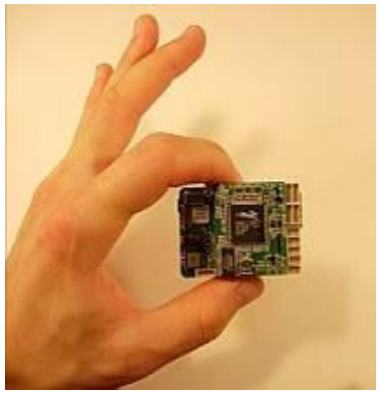
Objective:

Create autonomous miniature air vehicles (AMAVs) having unique technology features to serve

- Military markets
- Commercial markets

We produce:

- Vehicles
- Payloads
- Controls/autonomy
- Interfaces



Market Opportunities for UAVs

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Military:

- Intelligence, surveillance, and reconnaissance
- Attack of fixed and moving targets
- Communications node
- Suppress enemy air defenses

Civil and Commercial:

- Monitor environment – meteorology, pollution, mapping, mineral exploration, infrastructure surveillance
- Monitor disaster areas – forest fires, avalanches, nuclear contamination
- Law enforcement – road traffic, border patrol, drug control
- Communications relays – news broadcasts, disaster relief, sports events
- Precision agriculture – monitor crops, livestock

Unmanned Air Vehicles

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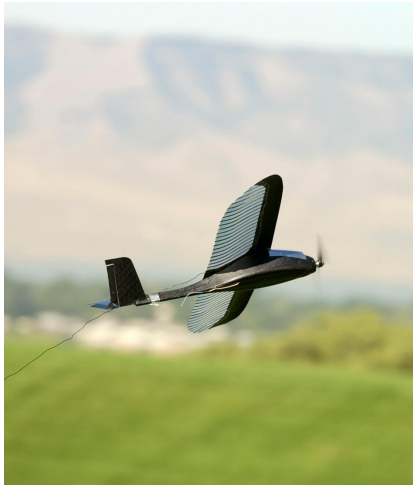
- State of the art:
  - Large
  - Expensive
  - Hard to fly – requires a team
  - High performance
  - Small quantities

- Center technology provides:
  - Autonomous Miniature Air Vehicles (AMAVs)
  - Small
  - Inexpensive
  - Capable, but lower performance
  - Easy to fly
  - Large quantities



AMAVs represent a "disruptive technology"

Milestones Accomplished

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1. Autopilot licensed – spin-off company created
2. Technology plan created – meets market need
3. Analysis has defined market opportunities
4. Proposals funded – $3.1M in past 3 years
5. Proposals submitted – $4.5M in past year
6. Many technical accomplishments leading to commercial opportunities

Technical Accomplishments

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- Autopilot miniaturization and enhancement
- Image directed control
- Improved trajectory tracking
- Cooperative control demonstration
- Improved operator interfaces
- New airframes
  - Inexpensive man-packable plane
  - Integrated camera plane

Benefits to Utah So Far

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BYU autopilot technology licensed to spin-off: Procerus Technologies of Provo, Utah

- $800K in revenue in first year of operation
  - 300 autopilots sold to Air Force, Army
- 4 full-time employees, average salary of $67K
- 90 percent of revenue stays in Utah
- Significant future opportunities
  - Autopilot supplier for 4 of 6 respondents to recent Air Force MAV Request for Proposals

Corporate Partners

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- Procerus Technologies – Utah start-up company, licensee
- Applied Research Associates – partner to deliver UAVs to military
- Northrop Grumman – autopilot user/partner
- Raytheon – autopilot user/partner
- Lockheed-Martin – autopilot user/partner
- SAIC – autopilot user/partner
- MITRE Corporation – autopilot user/partner

Intellectual Property

BYU

- Patent filed for autopilot technology

Currently manufactured and sold by
Procerus Technologies, Provo, Utah
www.procerus**uav**.com

- Provisional patents in process
  - Eye on Target
  - Focal Point video stabilization
  - Camera pan and tilt

US Aerial Surveillance Market

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	annual flight hours	cost per hour	annual spending	potential number of units per year	potential market
law enforcement	500,000	$500	$250M	1000	$15M
pipeline surveillance	4,000,000	$700	$2.8B	8000	$120M

Assumptions:

- 20% of manned helicopter hours replaced by AMAV hours
- AMAV useful life - 200 hours, 1 back-up
- AMAV unit cost - $15K

Note: At $500/hr, time to pay off unit cost is 30 hours

Other markets examined:

- Border patrol, forest service, traffic monitoring

Military Market Projections

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- DoD projected expenditures, FY 2003-2009
  - AMAVs: $63M per year
  - All UAVs: $2.7B per year
- Given success of UAVs and AMAVs in OEF and OIF, estimates are conservative
  - Aerovironment projects $300M per year
- BYU's AMAV market space
  - $20M+ now
  - Growing to $100M

Market Opportunity Summary

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Commercial	
Law enforcement	$15M
Pipeline surveillance	$120M
Military	$100M
Total	$235M

Funding Activity

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Total research funding: $4.2M (2000-2009)

- Support from AFOSR, AFRL, NASA, Army, DARPA
- Current external funding: $700K per year
- 6 to 1 match of COEP support

Technical Team

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Tim McLain (Mechanical Engineering)

- Visiting scientist – Air Force Research Lab
- PI on $950K of UAV research
- Cooperative control, trajectory generation and tracking

Randy Beard (Electrical and Computer Engineering)

- Lead developer of BYU autopilot technology
- PI on $1.0M of UAV research
- AMAV control, trajectory generation, team consensus

Mike Goodrich (Computer Science)

- Research staff – Nissan, USA
- PI on $1.3M of user interface research
- Efficient, natural man/machine interfaces

Jerry Bowman (Mechanical Engineering)

- International MAV competition champion team mentor
- MAV airframe design

Deryl Snyder (Mechanical Engineering)

- Technical lead on Air Force Tactical Mini UAV development
- Aerodynamic modeling, airframe development

Future Plans

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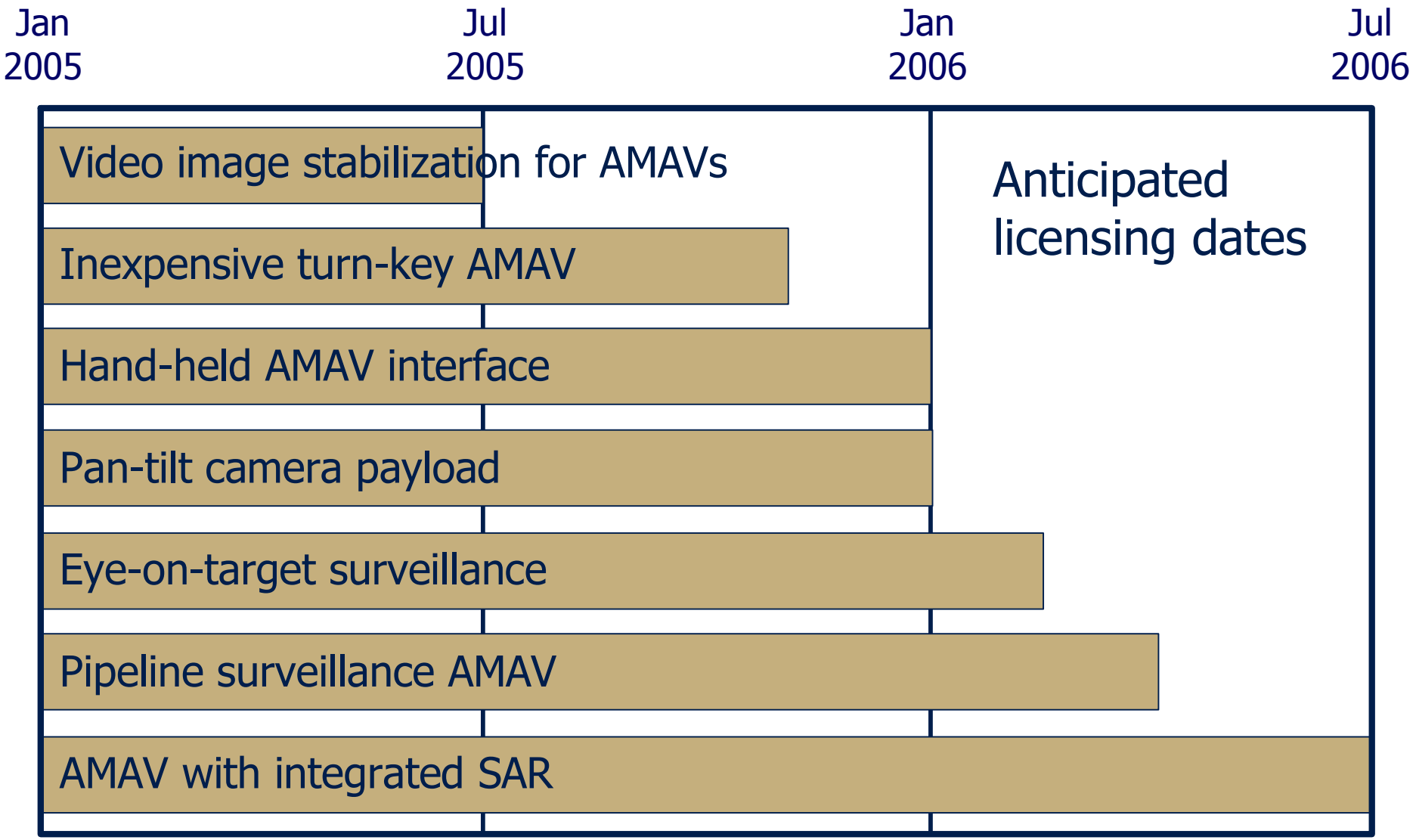

COEP Funding Request

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- Requesting $130K for 2005-2006 funding year
- Represents a 6 to 1 match

Questions?

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